PROPOSED RULE AMENDMENTS TO AUTHORIZE AUDIO VISUAL WARNING SYSTEM STATIONS UNDER PART 87 OF THE FCC'S RULES

I. Insert the following to Section 87.5 of the Rules

Audio Visual Warning System. An audio visual warning system (AVWS) is an integrated all-weather, day and night, low-voltage, radar-based obstacle avoidance system that utilizes existing obstruction lighting technologies. AVWS activates obstruction lighting and transmits audio warnings to alert pilots of potential collisions with obstacles, such as power lines, wind turbines, bridges and towers. The obstruction lights and audio warnings are inactive when there is no air traffic in the area of the obstruction.

II. Add the following new Subpart to Part 87 of the Rules

"Subpart T—Audio Visual Warning Systems"

§ 87.550 Scope of service.

An audio visual warning system (AVWS) is an all-weather, day and night, low-voltage, radar-based obstacle avoidance system that utilizes existing obstruction lighting technologies. AVWS activates obstruction lighting and transmits audio warnings to alert pilots of potential collisions with obstructions, such as power lines, wind turbines, bridges and towers. The obstruction lights and audio warnings are inactive when there is no air traffic in the area of the obstruction. As aircraft approach the obstruction, the continuously operating, low-powered radar calculates the location, direction and groundspeed of nearby aircraft that enter one of two warning zones reasonably established by the licensee. As aircraft enters the first warning zone, the AVWS activates the lights on the antenna structure or other obstruction to provide a visual warning to the pilot. If the aircraft continues toward the antenna structure or other obstacle and enters the second warning zone, the VHF radio transmits an audible warning to the flight crew.

§ 87. 552 Eligibility

Licenses for AVWS stations may be granted to persons that own or operate antenna structures or other air navigation obstructions subject to (a) Part 17, Subpart C of the Rules — Specifications for Obstruction Marking and Lighting of Antenna Structures; (b) 14 C.F.R. § 77.13; or (c) Chapter 1, Section 5 (b)(3) of the Federal Aviation Administration (FAA) Advisory Circular AC 70/7460-1K, entitled "Obstruction Marking and Lighting" as applicable to persons desiring to voluntarily mark and/or light antenna structures or other air navigation obstructions.

§ 87. 554 Frequencies

(a) Radiodetermination (radar) Frequencies.

(i) Frequencies authorized under § § 87.471(a) and 87.475 (b) (7) are authorized for use in AVWS stations. Upon request of the FAA, an AVWS station licensee shall apply to modify

its AVWS license to change the Radiodetermination (radar) frequencies to another frequency pair, available under § 87.475 (b) (7) of the Rules, as recommended by the FAA.

(ii) The maximum power for radiodetermination (radar) frequencies authorized under § 87.554(a)(i) of the Rules is two watts. The maximum EIRP is 20 dBW.

(b) Audible Warning Frequencies. Frequencies authorized under Sections 87.185, 87.187 (j) and (k), 87.213, 87.217 (a), 87.237, 87.241, 87.299, 87.303, 87.319, 87.232 (b) and (c), 87.345, 87.349, 87.371 and 87.375 of the Rules are available for assignment to persons requesting authority to operate AVWS stations solely for the transmission of audible warnings, subject to the Operational Limitations in subsection (c), below.

(c) Operational Limitations for Audible Warnings. AVWS stations must transmit audible warnings in accordance with the following limitations: (i) the output power for the audible warning transmissions shall not exceed 0.000501 (-3dBm) watt for each frequency available under Subsection(b); (ii) the audible warning shall not exceed two seconds in duration; (iii) no more than six (6) audible warnings may be transmitted in a single transmit cycle which shall not exceed 12 seconds in duration; and (iv) a twenty (20) second interval must occur before initiating the next transmit cycle.

(d) Performance Criteria for VHF Transmit Antennas. The antenna used in transmitting the audible warnings must be omnidirectional with a maximum gain equal to or lower than a half-wave centerfed dipole above 30 degrees elevation, and a maximum of +5 dBi gain from horizontal and up to 30 degrees elevation.

(e) Assignment of Multiple Frequencies for Audible Warnings. Multiple frequencies available under § 87.554(b) may be assigned to a single AVWS station as reasonably requested by the applicant based on the frequencies currently assigned for flight operations in the vicinity of one or more antenna structures or obstructions for which the AVWS station is being deployed. The applicant may be required to provide a statement in support of its multiple frequency request.

(f) Other Frequencies for Use in Connection with AVWS Stations. Persons eligible for AVWS station authorizations are also eligible for the assignment of frequencies under Part 90 of the Rules for use in connection with the operation of an AVWS station, except for those frequencies available to persons eligible under § 90.20, unless the AVWS applicant is eligible under § 90.20.

§ 87.556 Exemption from Continuous Lighting Requirements

Operators of antenna structures for which AVWS stations have been licensed and deployed are exempt from the continuous lighting requirements under § 17.51.

EXHIBITS

EXHIBIT 1

Federal Aviation Administration

Memorandum

Date: August 7, 2007

To: Thomas Toula, Manager, Air Transportation Division, AFS-200

From: David A. Downey, Manager, Rotorcraft Directorate, Aircraft Certification Service, ASW-100

Original signed by David A. Downey

Prepared by: Matthew Rigsby, Safety Mgt. Group, ASW-112

Subject: Obstacle Collision Avoidance System Affirmation

This is in response to your memorandum dated July 31, 2007 regarding the Obstacle Collision Avoidance System (OCAS). The Rotorcraft Directorate **FULLY** supports the acceptance of OCAS and OCAS type systems, to improve the overall safety of the aviation community.

The vision of the Federal Aviation Administration (FAA) Administrators "Flight Plan 2004 – 2008" is to reduce the number of general aviation accidents. As such, the Southwest Region Rotorcraft Directorate is firmly committed to the acceptance of OCAS in the United States as way of reducing the general aviation accidents and saving lives. Just a few of the statistics:

- A review of FAA accident incident data shows that Wire and Obstruction strike accidents are the top operational cause of rotorcraft accidents for the period of 1996 to 2006, and 35% of those accidents are fatal.
- National Transportation Safety Board statistics show a total of 996 reported aviation accidents/collisions involved power lines from January 1, 1990 to October, 2003. Of the 996 accidents, 301 involved at least one fatality. (This is for power lines only and does not include guide wires, towers, and other elevated structures.)

It is our belief that the problem of obstacle collisions deserves a better solution than current conventional visual markings. *Saving Lives Through Collision Avoidance* is a Number One priority and the reason we have committed to an effective and comprehensive evaluation and ultimate acceptance of OCAS and OCAS type systems. The cost of wire strikes not only in lives, but in power interruptions and subsequent

re-routing and repairs, and the economic impact to the public is staggering. Utility experts report that a 500 Kva line can generate upwards of one million dollars per hour.

Our Safety Management Group, ASW-112, is the office that originally brought the OCAS system to the FAA's attention after communications with Helicopter Association International (HAI) and utility stake holders back in 2003. They began looking at reducing helicopter accidents due to wire strikes and have participated in successful flight tests of the OCAS field evaluations in both Norway and in the United States. The last successful flight test was conducted with the AFS-250 Flight Standards representative in August of 2005. Two helicopters (Jet Ranger and MD-500) and a general aviation Grumman, AA-5A Cheetah were used for test and demonstration purpose. The Jet Ranger with representatives from FAA and Transport Canada as observers on board was used and the MD-500 was used with representatives from the Norwegian Civil Aeronautics Authority (CAA). In addition, OCAS test members conducted additional flight test both the 29 and 31 August, including General Aviation (GA) aircraft, the Cheetah. Six flights with a total of 77 test runs were performed.

During the 77 test runs, including pretests, the helicopter and the Cheetah crossed the Milton power line river crossing at different altitudes and angles to the power lines in order to activate the OCAS warnings as well as flying to the side of, and above the obstacle warning zone to demonstrate that aircraft flying at a safe distance away from the obstacle would not activate (unnecessary) warning actions. Additionally, simulated float airplane landing patterns were flown into the warning zone for simulated landings on the river beyond the power lines with the objective to activate timely light and audio warnings.

This testing and evaluation was conducted with the participation of the Norwegian CAA and TC officials. Each of the countries have already accepted the OCAS as an equivalent and superior obstruction marking and lighting alternative to existing technology. Several other countries are in the process of obtaining this same acceptance. If the FAA is to remain one of the world leaders in aviation safety, acceptance of OCAS and/or OCAS type systems are imperative.

OCAS provides a 24/7 365 day/night "safety net" around obstructions. This proven system combines both the visual indications and an accompanying audio warning as well. Current FAA/FCC input has limited the audio broadcast to just the air-to-air for fixed wing and air-to-air for helicopters. This is seen as a SEVERE limitation and for OCAS to have the biggest positive impact on aviation safety the frequency bands need to be opened up to ensure the greatest opportunity to alerting an aircraft/pilot they are on a potentially life threatening course and to take appropriate action. The OCAS system is breakthrough technology which was developed through a joint effort involving the aviation community, aviation regulators and the utility industry in Norway. It was designed to engineer out all of the concerns and shortcomings of the

existing lighting and marking systems in use today. To date, it has found wide acceptance by all stakeholders in the wire and obstruction marking initiative as a replacement technology to existing systems. These stakeholders include the Aviation Regulators, the Aviation Community, and Obstruction Owners. In particular, OCAS's provides real time system status monitoring to immediately alarm multiple stakeholders the instant there is a lighting outage or other system failure. This is tremendous advantage over the current systems where failed lighting and marking systems can remain unlit for several years, for the simple fact that no one checks on it.

The Rotorcraft Directorate has been in close communications with aviation industry groups, aviation utility experts, and utility/obstruction owners. (See attached letter from Utility Aviation Specialist Inc.) OCAS provides to the wire and obstruction environment as well as the aviation community a tremendous improvement in safety at no cost to the flying public. OCAS type systems have the potential to save both lives and prevent critical utility infrastructure outages.

Saving Lives Through Collision Avoidance!!

Attachment

EXHIBIT 2

FLIGHT TEST REPORT

Obstacle Collision Avoidance System
(OCAS)

OCAS Demonstration – FAA Acceptance
(Transport Canada and Norwegian CAA participants)

Milton, KY, August 2005

Document #: OCAS RB 0002
Date: 15.10.2005
File name OCAS Demonstration – FAA Acceptance
Rev

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SECTION 1 – INTRODUCTION

1.1 PURPOSE OF TEST

A system demonstration and FAA acceptance of the Obstacle Collision Avoidance System (OCAS) was conducted in Milton, Kentucky 29-31 August 2005. The demonstration and acceptance was conducted by a team of members from the FAA, Transport Canada (TC), The Norwegian CAA, Kitron Development AS (Kitron) and OCAS-AS, with excellent support from Kentucky Utility and Orga Inc (strobe light manufacture).

The objective of the Obstacle Collision Avoidance System (OCAS) is to greatly reduce the number of collisions between aircraft and manmade aviation obstacles, such as power lines and towers. A power line crossing, owned by Kentucky Utilities, in the Milton area across the Ohio river, with an installed OCAS Field Unit (Type B) was used for the demonstration and acceptance. Test site information is enclosed in Appendix A.1.

The objective of the OCAS system demonstration was to achieve FAA acceptance of the OCAS system's ability to warn pilots of manmade obstacles, including assessment of the OCAS system functionality and quality of the warning actions provided. A previous OCAS system demonstration had been conducted in October 2004, which concluded with several areas of system performance to be unsatisfactory and to be improved.

The demonstration and acceptance conducted in August 05 met all test objectives and FAA requirements with excellent and consistent results.

1.2 SCOPE OF TEST

Two helicopters (Jet Ranger and MD-500) and a general aviation Grumman, AA-5A Cheetah were used during the demonstration and acceptance. The Jet Ranger with representatives from FAA and TC as observers on board was used 29 August, and the MD-500 was used with representatives from the Norwegian CAA the 31 August. In addition, OCAS members conducted additional flights both the 29 and 31 August, including General Aviation (GA) aircraft, the Cheetah. Six flights with a total of 77 test runs were performed. A summary of the flights are enclosed in Appendix A.3.

Prior to the FAA Demonstration two pre-test flights were conducted 29 August with a GA aircraft and the Jet Ranger to verify system performance. The flights included a total of 48 test runs. The results are included in this report. The Jet Ranger flight test was debriefed with the FAA and TC during the demonstration phase.

During the 77 test runs, including pre-tests, the helicopter and the Cheetah crossed the Milton power line river crossing at different altitudes and angles to the power lines in order to activate the OCAS warnings as well as flying to the side of, and above the obstacle warning zone to demonstrate that aircraft flying at a safe distance away from the obstacle would not activate (unnecessary) warning actions. Additionally, simulated seaplane landing patterns were flown into the warning zone for simulated landings on the river beyond the power lines with the

objective to activate timely light and audio warnings.

1.3 OBJECTIVES

The main objective of the demonstration flights was to demonstrate the operational functionality of the OCAS warning system to achieve regulators (FAA, TC and CAA) acceptance of the OCAS system and its ability to warn pilots of obstacles protected by the OCAS system.

All test objectives were met with satisfactory results.

1.3.1 Verify that warning actions are correctly triggered with aircraft entering the warning zones with different flight parameters.

Successful criteria: No false warnings should be observed.

Results: No false warnings were observed during a total of 77 test runs. Test results satisfactory.

1.3.2 Verify that light and audio warnings are triggered allowing the pilots sufficient time and airspace to perform a safe collision avoidance maneuver:

Successful criteria:
a. Low speed targets (< 250 kts):
Strobe light should be activated no later than audio warning signal, and preferably 30 seconds prior to obstacle crossing. Audio warning signal should be activated approximately 20 seconds (+/- 3 sec) prior to obstacle crossing.

Results:
The activation of audio warning occurred between 19.4 seconds and 25.8 seconds prior to actually crossing the power line, with an average time of 22.5 seconds. Test results satisfactory.
The activation of strobe light warning occurred between 25.4 seconds and 37.5 seconds prior to actually crossing the power line, with an average time of 33.7 seconds. Test results satisfactory.

1.3.3 Verify correct transmitted VHF signal throughout the test program.
Result: Verified, no deficiencies noted, test results satisfactory.

1.3.4 Verify that audio warning is distinct and easily recognized by the pilot.
Result: Verified, test results satisfactory.

1.3.5 Verify no transmission on step frequencies when audio warning is activated.
Result: Verified, test results satisfactory.

1.3.6 Verify that the warning light signal facilitate visual detection of the obstacle.

Result: Verified, however it should be noted that bright day light may in general reduce the effectiveness of the strobe lights. This is a known problem and not related to the OCAS system

specifically. Test results satisfactory.

1.3.7 Verify that warning light will activate and remain on if OCAS subsystem fails.

Result: Verified, test results satisfactory.

1.3.8 Evaluate and verify radar performance and coverage.

Successful criteria:
a. Light and Audio warning must be activated from ground level to top of obstacle + 200 ft
b. Light and Audio warning may be activated in the range from top of obstacle + 200 ft to + 500 ft.
c. Light and Audio warning should not be activated above top of obstacle + 500 ft.

Results: Timely and precise warnings were recorded respectively when applicable. All warnings within a. were excellent. No warnings were recorded at or above requirements in c. (above 1350 ft MSL). Test results satisfactory.

1.4 INSTRUMENTATION AND DATA REDUCTION

1.4.1 Aircraft true track reference

A GPS was carried on board the helicopters and the Cheetah to provide true track reference for comparison with recorded radar data obtained from the OCAS OCC (OCAS Operational Control Center).

1.4.2 Hand held data

1.4.2.1 Timing of audio warning activation.

Activation time of audio warning was observed via VHF radios tuned to 121.750/123.025 MHz, both in the aircraft and on the ground. Timing from activation of warning actions until aircraft crossed over the wires were visually measured and timed with a handheld digital watch. Timing error estimated to +/- 1 second measured in the aircraft.

1.4.2.2 Timing of warning lights activation.

Activation time of warning lights was observed from the cockpit and the ground. Timing from activation of warning actions until aircraft crossed over the wires were visually measured and timed with a handheld digital watch. Timing error estimated to +/- 1 second measured in the aircraft.

1.4.3 OCAS Control Center (OCC)

Radar log and warning log provided by OCC to provide the basis for a system performance analysis. The data was compared and analyzed with reference to aircraft GPS track and

handheld data recorded in the test aircraft and on the ground.

SECTION 2 – RESULTS, DISCUSSION AND CONCLUSION

2.1 ASSESSMENT OF SYSTEM FUNCTIONALITY

A total of 77 flight runs were performed during the demonstration. Details concerning the Warning Zone are provided in Appendix A.2. Flight test runs performed, are detailed in Appendix A.3 and Appendix A.4.

2.1.1 Test runs flown thought the Warning Zone with intent to activate OCAS warnings.

A total of 49 flight runs were flown at various heights and locations along the obstacle with the intention of activating the OCAS warning actions in the "Must Warn" zone. This warning zone was defined to be the highest obstacle, tower on the North side (850 ft MSL) + 200 ft. "Must Warn" zone was defined to be 850 ft+200 ft= 1050 ft MSL. During all runs both warning lights and audio warning was activated indicating that the OCAS radar was able to detect and track the GA aircraft and the test helicopter during all 49 flight runs.
The activation of audio warning occurred between 19.4 seconds and 25.8 seconds prior to actually crossing the power line. Only one test run with time less than 20.0 seconds was observed. Average audio warning activation time was recorded with respect to the 6 flight tests: 22.6 / 22.5 / 22.0 / 23.0 / 21.3 and 22.3 seconds. The OCAS radar's capability of detecting and tracking aircraft approaching the obstacle from various likely approach sectors, as well as producing target velocity data to provide timely and consistent activation of audio warning were acceptable.

2.1.2 Test runs flown outside the Warning Zone with intent not to activate OCAS warnings.

A total of 14 test runs were flown to the side or above the warning zone to verify no activation of OCAS warnings. The altitude band between 1050 ft and 1350 ft was defined as a "May Warn" zone. No activation of warnings was observed at or above 1350 ft MSL. Several of the 14 test runs were flown at 1250 and 1300 ft MSL, without warnings. The accuracy of the radar was measured to +/-150 ft at 1,500 meters, and the requirement of no warning above the obstacle + 500 ft were met. No nuisance warnings were observed during the entire test effort (6 flights total). The demonstrated capability to avoid activating (nuisance) warning to aircraft following a non conflicting track close to the obstacle was satisfactory.

2.1.3 Test runs flown in the "May Warn" zone.

The "May Warn" zone was defined to range from the obstacle +200 ft and the obstacle +500 ft. The may zone was defined to be above 1050 ft to include 1350 ft MSL. There may be timing both with respect to audio and strobe lights less than the described 20 sec for audio and 30 seconds (not less than audio) for the strobe lights in this zone. This may be a result of the fact that the radar accuracy may vary depending on distance, turbulence or aircraft changing altitude which may result in immediate warnings. All test runs observed in the "may zone" during 6 flights were satisfactory, and combination of only lights or lights and audio simultaneously

were observed and recorded. See appendix A.2

2.2 ASSESSMENT OF AUDIO WARNING SIGNAL

2.2.1 Audio warning signal strength and quality.

Prior to start of flight runs the limited range of the transmitted audio warning signal was demonstrated with preset signal strength set for the functional test (– 3 dbm). The OCAS warning radio was set to transmit audio warning signals on two frequencies, 121.750 and 123.025 MHz.

At a distance approximately 2 nm away from the OCAS Field Unit the audio warning signal received through the helicopter's VHF-radio was "loud and clear". At approximately 3 nm the received signal was "weak and intermittent" and at 4.5 nm the received signal was "very weak and unreadable". The limited range of the transmitted audio warning signal demonstrated the low impact and limited disturbance of warning signal transmissions to other air traffic. Appendix A4 depicts the actual track flown during this test.

During the test runs performed to activate OCAS warning actions the audio warning signal was received load and clear in the test helicopter and GA aircraft and the warning transmission was considered easy to recognize and distinct to the evaluating helicopter and GA aircraft crew. The audio warning consisted of a total of 12 seconds duration, including the word "powerline" repeated 3 times in each cycle. The warning cycle was repeated a total of 6 times.
The audio warning signal strength and quality was considered satisfactory by the assessing crew as the range of the signal was limited, however at the same time was heard "loud and clear" when audio warnings were issued to the helicopter performing the flight runs.

2.2.2 Activation time of OCAS audio warning signal.

The activation of audio warning occurred between 19.4 seconds and 25.8 seconds prior to actually crossing the powerlines, with an average time of 22.5 seconds. Previous discussions with FAA and operational pilots the goal is to issue audio warning not later than 20 seconds (+-3 seconds) prior to reaching the obstacle (predicted impact). The activation time of the audio warning was considered satisfactory and provided sufficient time for the pilot to react to the warning, assess the situation and take proper evasive action based on the "see and avoid" concept.

2.3 No OCAS transmission on step frequencies during audio warning

Several tests were conducted to verify that there will be no OCAS audio warnings transmitted on step frequencies. Primary frequency used was 123.025, and step frequencies were verified to receive no audio warnings as designed.
Further, it was demonstrated that simultaneous VHF voice transmissions and audio warnings will allow the voice transmissions to override the audio warning. The audio warning will be noticeable at the same time. The strength of the voice transmission was determined to range from a quality of 3 to 5 (readable to loud and clear).

2.4 ASSESSMENT OF LIGHT WARNING SIGNAL

Orga strobe lights (20,000 cd) were installed in both the North and South tower. Both strobe lights were performing excellent throughout the test flights. Both lights were at all times being activated simultaneously with synchronized flashes. Once the strobe lights were activated, the lights would flash for a total of 60 seconds. This time may be altered, but OCAS experience shows this to be satisfactory and useful to identify the obstacles throughout the "see and avoid maneuver".

The warning time (activation of strobe lights) was required to be optimized at 30 seconds but no less than audio warning. The average strobe light warning times were recorded with respect to the 6 flights: 33.2 / 34.3 / 33.4 / 33.0 / 33.2 and 34.1 seconds. The results were excellent and well within the requirements.

The testing was performed in both bright sunlight conditions and reduced visibility. It was noted that the effectiveness of warning lights during bright sunlight conditions depended on the position of the sun relative to aircraft heading. Further the effectiveness of the warning lights depended on the aircraft altitude relative to the height of the strobe lights. This problem is related to obstruction warning lights in general, and is one of the weaknesses addressed by the OCAS system. When looking into the sun the lights were sometimes difficult to detect and the audio warning signal provided the best obstacle warning. When flying at low altitude, it was

2.5 ASSESSMENT OF RADAR MEASUREMENT ACCURACY

Appendix A.5 presents radar measurement accuracy from all 6 flights. The results have been calculated comparing radar and GPS log files. The main parameters relevant to the OCAS warning system are measurement errors in height, range and time-to-impact. Figures 1- 3 in Appendix A.5 show the corresponding statistics in terms of measured parameter error (black dots), mean value (magenta line) and standard deviation (red line) versus range.

The VHF warning signal and the strobe lights were configured for activation 20 and 30 seconds before impact. Most runs were conducted at approximately 100 kts, and the corresponding warning ranges were at approximately 1000 and 1500 meters.

2.5.1 Measured height error versus range (Appendix A.5, figure 1). At 1000 meters all measurements are within +/- 25 meters (83 feet) and the standard deviation is 13 meters (43 feet). At 1500 meters all measurements are within +/- 30 meters (100 feet) and the standard deviation is 19 meters (63 feet).

2.5.2 Measured range error versus range (Appendix A.5, figure 2). At 1000 and 1500 meters all measurements are within +/- 100 meters (300 feet) and the standard deviation is 40 meters (132 feet).

2.5.3 Measured time-to-impact error versus range (Appendix A.5, figure 3). At 1000 meters all measurements are within +/- 3 second and the standard deviation is 1second. At 1500 meters all measurements are within +/- 3seconds and the standard deviation is 1.7 seconds.

Conclusion: The measurement statistics show that the radar sensor accuracy is sufficiently good to meet the overall system requirements.

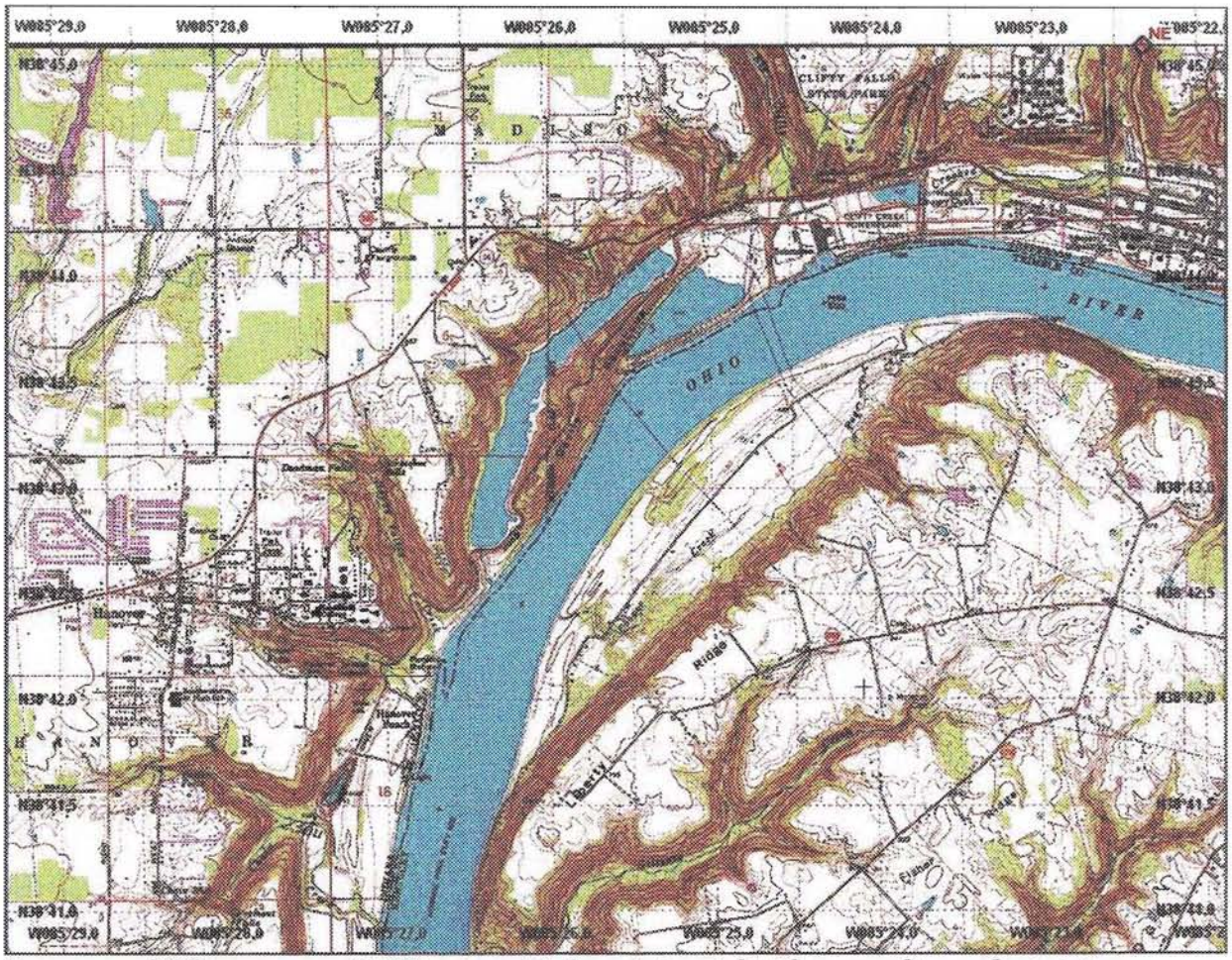
2.6 CONCLUSION

All test objectives were met. The OCAS system met all systems and operational requirements with excellent results.

Appendix A.6 includes "Transport Canada Test Report at Milton 29-31 August 2005"

15 Oct 2005
Rolf Bakken
OCAS-AS

APPENDIX A.1. Test Location, Milton KY



Topo map of Milton area – with Ohio river. Madison is top right. The power line under test is the southwestern crossing, owned by Kentucky Utility. The OCAS field unit is sitting on the southeastern river bank, below the power line. Grid is degrees, minutes and decimal minutes.

APPENDIX A.2. OCAS warning zone, Milton

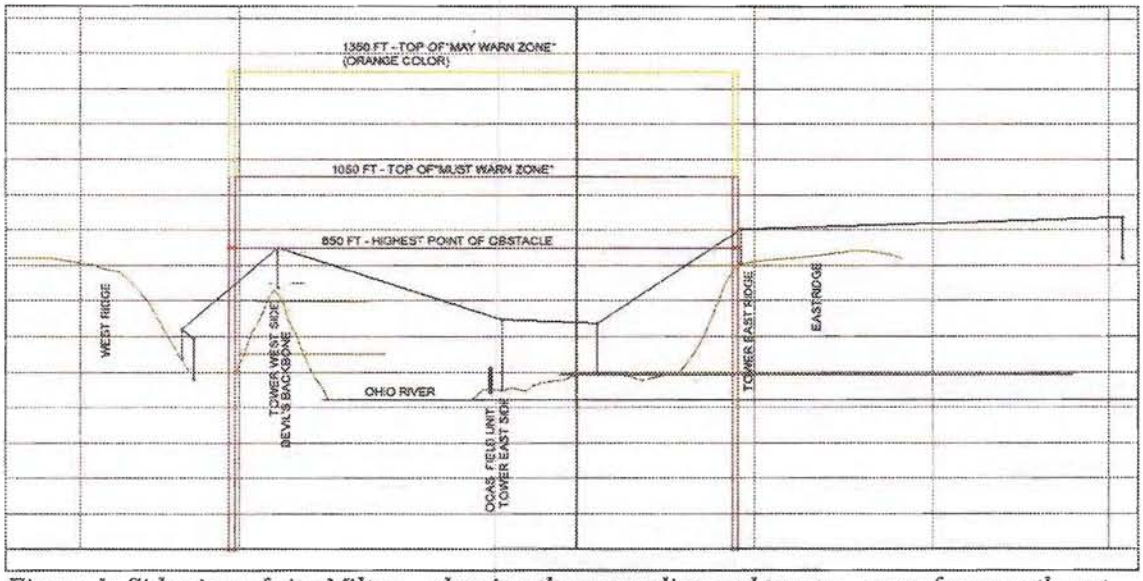


Figure 1: Side view of site Milton – showing the power line and towers – seen from southwest towards northeast. OCAS FU (field unit) is the thick short line near east tower.
View is towards northeast. Red and orange prisms is/are the warning zone(s). Brown line is terrain profile under the warning zone (power line river crossing)

APPENDIX A2. OCAS warning zone, Milton, continued

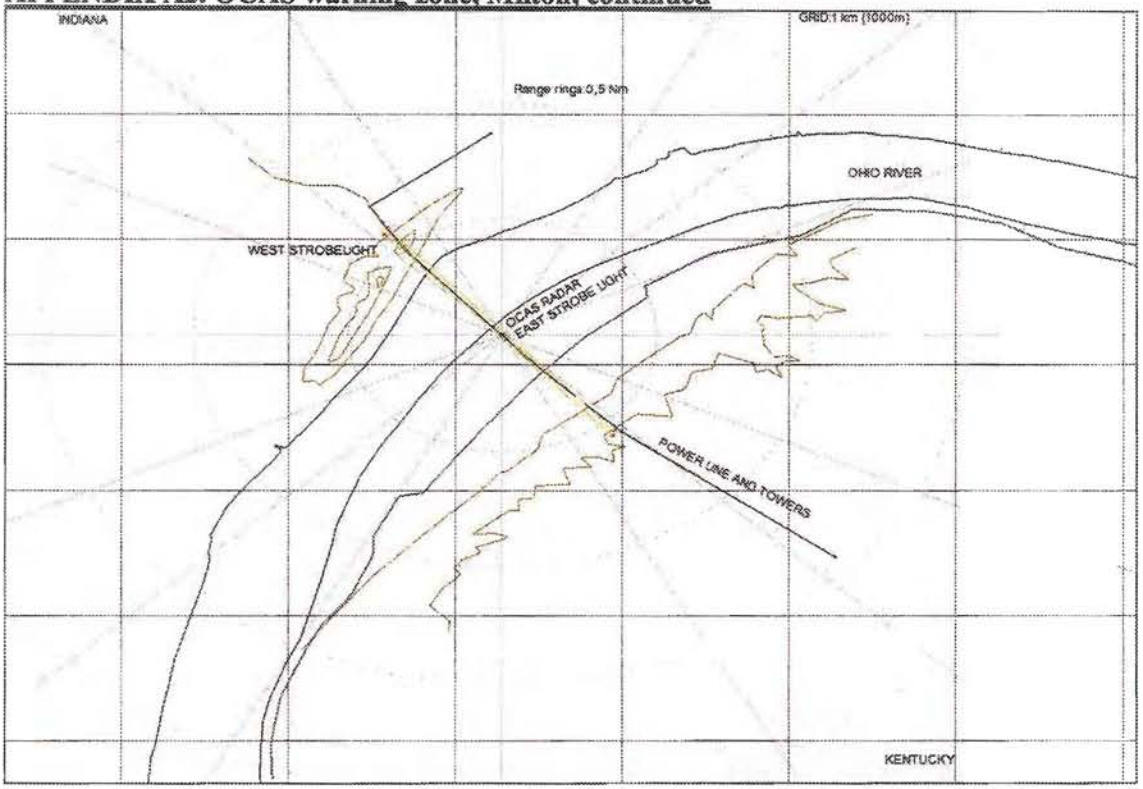


Figure 2: top view - blue lines are river banks, brown (olive green) are constant elevation topo curves (550 / 800 ft at southeast side, 500 / 700 / 750 ft at northwest side). Grey line is road at Kentucky side – assumed constant elevation for simplicity. Light blue pattern is 0,5 Nm range rings from radar position.

APPENDIX A.3. Test results

3.1 – Debrief Form, OCAS evaluation- GA aircraft.
Flight #1, cg

Date: **29 Aug 2005** Mast: **Milton** Pilot: Ralph Rogers (812 599 4381) / Rolf Bakken A/C reg: N-26316 A/C type: Grumman, AA-5A Cheetah Takeoff: 09:10
Landing: 10:48 Tot time: 1:38

ID run #	Pos	In (Time local) +5 Z	Hdg Deg	Alt MSL (ft)	IAS (kts)	Strobe	Audio signal			Ovh Obs (sec)	Audio Warn (sec)	Rmk #
						Start (N)	Start (sec)	Stop	Qual (1-5)			
1	90 Deg	09:14	Sw	**900**	100	X	+9.6	6x	5	+32.3	22.7	
2	"	:18	Nw	"	"	X	+10.5	6x	5	+34.7	24.2	
3	"	:20	Sw	**1000**	"	X	+9.6	6x	5	+30.8	21.2	
4	"	:23	Ne	"	"	X	+9.5	6x	5	+32.7	23.2	
5	"	:25	Sw	**1050**	"	X	+8.7	6x	5	+29.2	20.5	
6	"	:28	Ne	"	"	X	+10.7	6x	5	+33.3	22.6	
7	"	:31	Sw	"	"	X	+9.6	6x	5	+32.2	22.6	
8	"	:34	Ne	"	"	X	+10.6	6x	5	+32.7	22.1	1
9	"	:36	Sw	"!	"	X	+9.6	6x	5	+32.7	23.1	
10	"	:39	Ne	"	"	X	+10.1	6x	5	+33.7	22.6	2
11	"	:42	Sw	**1100**	"	X	+8.6	6x	5	+28.8	20.2	
12	"	:45	Ne	"	"	X	+10.5	6x	5	+34.4	23.9	
13	"	:48	Sw	**1200**	"	-	-	-	-	-		
14	"	:51	Ne	"	"	-	-	-	-	-		
15	"	:54	Sw	1200-1250	"	X	+7.8	6x	5	IMC	NA	3
16	"	:56	Ne	**1300**	"	-	-	-	-	-		4
17	"	:59	Sw	"	110	X	-	-	-	+~20	20	5
18	"	10:01	Ne	**1250**	"	X	X	6x	5	+22.4	22.4	
19	"	:04	Sw	**1300**	100	X	+10.0	6x	5	+28.0	~18	6
20	"	:07	Ne	**1050**	105	X	+10.8	6x	5	+33.6	22.8	
21	"	:10	Sw	"	"	X	+8.6	6x	5	+28.6	20.0	
22	"	:12	Ne	"	"	X	+14.3	6x	5	+37.2	22.9	
23	260	:16	260	**1300**	"	X	+7.3	6x	5	+28.6	21.3	
24	90	:18	Ne	"	"	X	+4.9	6x	5	+26.6	21.7	7
25	"	:20	Sw	**1350**	"	-	-	-	-	-		

ID run #	Pos	In (Time local) +5 Z	Hdg Deg	Alt MSL (ft)	IAS (kts)	Strobe	Audio signal			Ovh Obs (sec)	Audio Warn (sec)	Rmk #
						Start (N)	Start (sec)	Stop	Qual (1-5)			
26	90 Deg	10:23	Sw	**1350**	100	-	-	-	-	-		
27	"	:26	Nw	"	"	-	-	-	-	-		
28	"	:29	Sw	**1050**	"	X	+12.6	6x	5	+34.9	22.3	
29	"	:32	Ne	**1000**	"	X	+8.7	6x	5	+30.6	21.9	
30	015	:35	025	"	"	X	+13.3	6x	5	+39.5	25.8	
31		:38										8
32	180	:39	180	**1150-1000**	"	X	X	6x	5	+14.9	14.9	9
33	260	:42	260	"	"	X	+12.7	6x	5	+35.3	22.7	
34	280	:45	280	**1000**	"	X	+11.5	6x	5	+34.3	22.8	

REMARKS:

Warning Zone: 320m+15+15= 350 m (1150 ft MSL)
Audio: 20+1+3 s Arm 33s (previous 21/33)
SL: 34+2 Arm 44 (previous 34/44)

AWS set to **1150' msl**, (350 ft above North tower). The width of Warning Zone set to +- 25 m. A lower limit of 180 m (OCAS + 20 m) was set to avoid "targets below OCAS in sector 000-030) **or** minimum 15 m/s (30 kts)

WZ height = 1150 ft (320+15m+15 m= 350 m). Top of twr North: 850 ft MSL (260 m). Top of twr South: 760 ft (232 m). Ground level, river: 420 ft. Spann length 3120 ft (950 m)

Warning: Always below 1050 ft. May between 1050 – 1350 ft. Not above 1350 ft.

Frequency: 123.025. Signal strength= **00 dB (-3dbm) – Gives range of 4 nm +/-1/4 nm**

GPS recorded data:
- "Mil 29 1" = Run 1-11
- "Mil 29 2" = Run 12-22
- "Mil 28 3" = Run 23-32
- "Mil 29 3"= Run 33-34

RESULTS (Note#):
General:
No turbulence, smooth air. Clouds (stratus) initially at approx 1200 ft, increasing to 1400 ft during test. Few runs in partly IMC conditions, unable to determine exact crossing of powerline (Run 15-17-19)

No False Warnings.
Stable system.

Remark:
1). Small climb/descend at +35 sec, run-ok.
2). Increase of "pause" between AW, same track ID from 8.0 sec to 20.0 sec.
3). No timing due to IMC
4). No timing due to IMC.
5). Immediate warn ? Partly IMC
6). Immediate warning, just on border of WZ, partly IMC-timing unsure.
7). Small climb/descend (unstable run), result ok.
8). Run flown outside warning Zone. Test run not applicable.
9). Run flown outside warning Zone (Hdg outside warn zone). Test run not applicable.

Oslo 5 Sep 05
Rolf Bakken

APPENDIX A.3. Test results, continued

3.1 – Debrief Form, OCAS evaluation- Helicopter

Date: **29 Aug 2005** Mast: **Milton** Pilot: Robert Poe (812 246 5454) / Rolf Bakken
A/C reg: N-860DP A/C type: Jet Ranger C30B Takeoff: 13:00
Landing: 13:50 Tot time: :50

ID run #	Pos	In (Time local) +5 Z	Hdg Deg	Alt MSL (ft)	IAS (Mph)	Strobe	Audio signal			Ovh Obs (sec)	Audio Warn (sec)	Rmk #
						Start (N)	Start (sec)	Stop	Qual (1-5)			
1	90 Deg	13:04	Nw	**900**	110	X	+10.0	6x	5	+33.9	23.9	
2	"	:09	Sw	"	"	X	+10.5	6x	5	+33.1	22.6	
3	"	:13	Ne	**1000**	"	X	+11.5	6x	5	+33.4	21.9	
4	"	:16	Sw	"	"	X	+11.5	6x	5	+32.6	21.1	
5	"	:18	Ne	**1050**	"	X	+11.6	6x	5	+34.1	22.5	
6	"	:21	Sw	"	"	X	+9.6	6x	5	+32.4	23.0	
7	"	:23	Ne	**1100**	"	X	+6.0	6x	5	+25.4	19.4	1
8	"	:26	Sw	"	"	X	+7.4	6x	5	+30.2	22.8	
9	"	:29	Ne	**1300-1280**	"	-	-	-	-	-	NA	
10	"	:31	Sw	1300	"	-	-	-	-	-	NA	
11	010	:34	010	**1000**	"	X	+14.6	6x	5	+37.5	22.9	
12	275	:38	270	"	"	X	+15.4	6x	5	+37.3	21.9	
13	90	:42	Ne	**1200**	"	X	+13.8	6x	5	+34.1	20.3	1
14	"	:45	Sw	"		X	+8.5	6x	5	+29.1	20.6	

REMARKS:

Updated terrain correction. Warning Zone: 320m+15+15= 350 m (Radar +-30 m).

AWS set to **1150' msl**, (350 ft above North tower). The width of Warning Zone set to +- 25 m. A lower limit of 180 m (OCAS + 20 m **or** minimum 15 m/s (30 kts)

WZ height = 1150 ft (320+15m+15 m= 350 m). Top of twr North: 850 ft MSL (260 m). Top of twr South: 760 ft (232 m). Ground level, river: 420 ft. Spann length 3120 ft (950 m)

Warning: Always below 1050 ft. May between 1050 – 1350 ft. Not above 1350 ft.
Frequency: 123.025/121.700. Signal strength= **00 dB (-3dbm) – range of approximately 4 nm +/-1/4 nm**

GPS recorded data:

- "Mil 29 20" = Run 1-10
- "Mil 29 21" = Run 11-14

RESULTS (Note#):
Run to be analyzed:
All for final report. No deficiencies noted, excellent performance.

General:
Very good results.
Good flying conditions.
No False Warnings.
No warnings at or above 1300 ft.
OCAS stable/timely warnings.

1). Slight descend 1100 ft to 1050 at approximately +35 sec-results good ("unstable flight Run).

Milton 29 Aug 05
Rolf Bakken